

July 1997

Preliminary Data Summary

by Field Research Facility

U.S. Army Corps of Engineers
Waterways Experiment Station
Coastal and Hydraulics Laboratory
1261 Duck Road
Duck, NC 27949-4472

Contents

Preface	iv
1 Introduction	1
2 Meteorological Data	7
3 Wave Data	12
4 Current Data	17
5 Visual Observations	20
6 Water Levels	22
7 Bathymetry	24

List of Figures

<u>No.</u>		
1	FRF Location Map	2
2	Month at a Glance	3
3	Instrument Locations at FRF	6
4	Meteorological Monthly Summary	8
5	Wave Heights and Periods	16
6	Water Levels	22
7	CRAB Profiles	24
8	CRAB Profile Envelope	25
9	FRF Bathymetry (17 June 97)	26

List of Tables

<u>No.</u>		
1	Instrument Status/Data Availability	4
2	Gauge Locations	5
3	Meteorological Data	9
4	Wave Data	13
5	Current Meter Data	18
6	Visually Observed Current Data	19
7	Visual Observations	21
8	Water Levels	23

Preface

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

Data from these reports are now available via the World Wide Web at
<http://www.frf.usace.army.mil>

These web pages contain general information about the Field Research Facility and data from 1980 to the present.

Your comments and suggestions are welcome.

Introduction

1

The U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the National Geodetic Vertical Datum (NGVD) of the year 1929.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919)261-6840 ext.222 (c.baron@cerc.wes.army.mil).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 2.

Times given in the report are referenced to eastern standard time (EST).

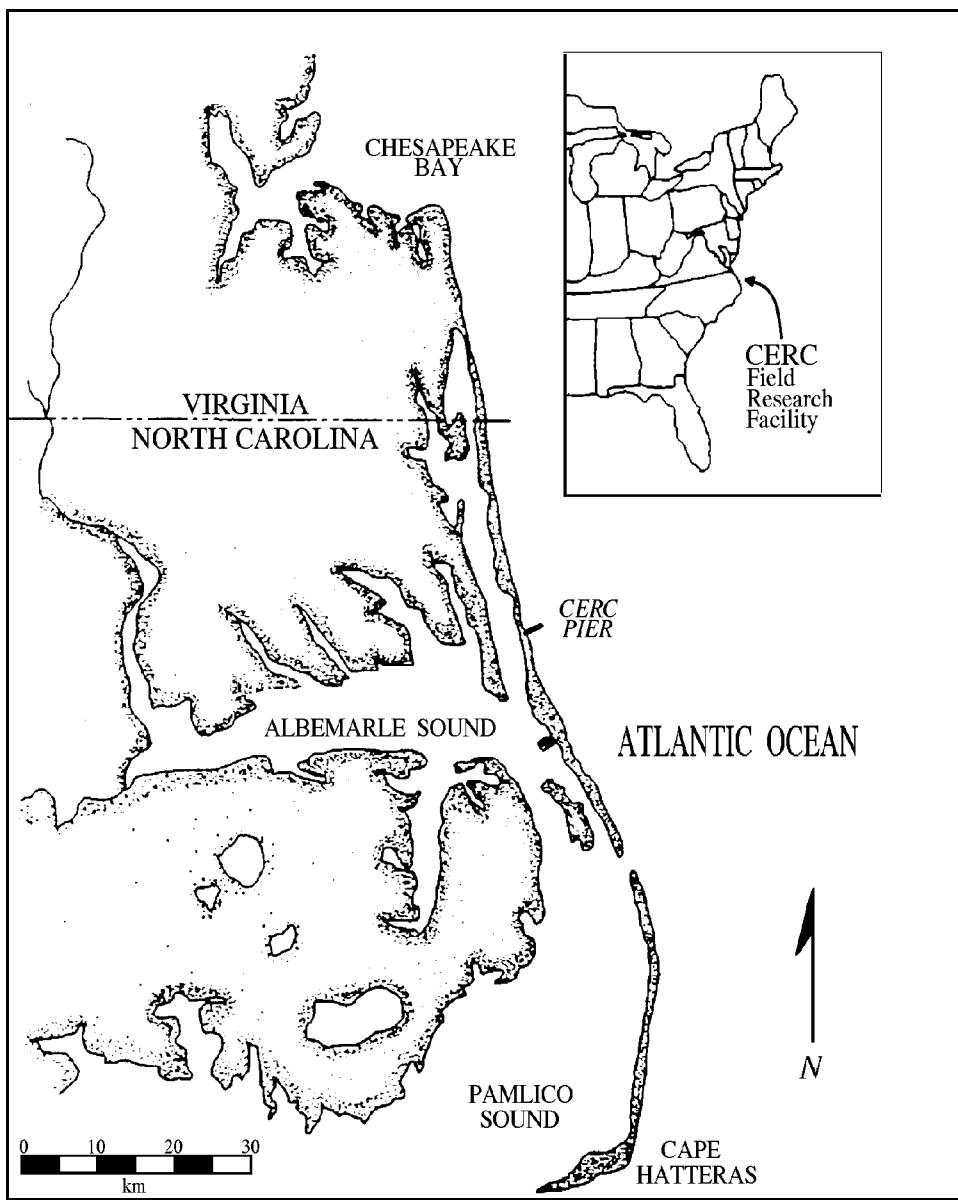


Figure 1. FRF Location Map

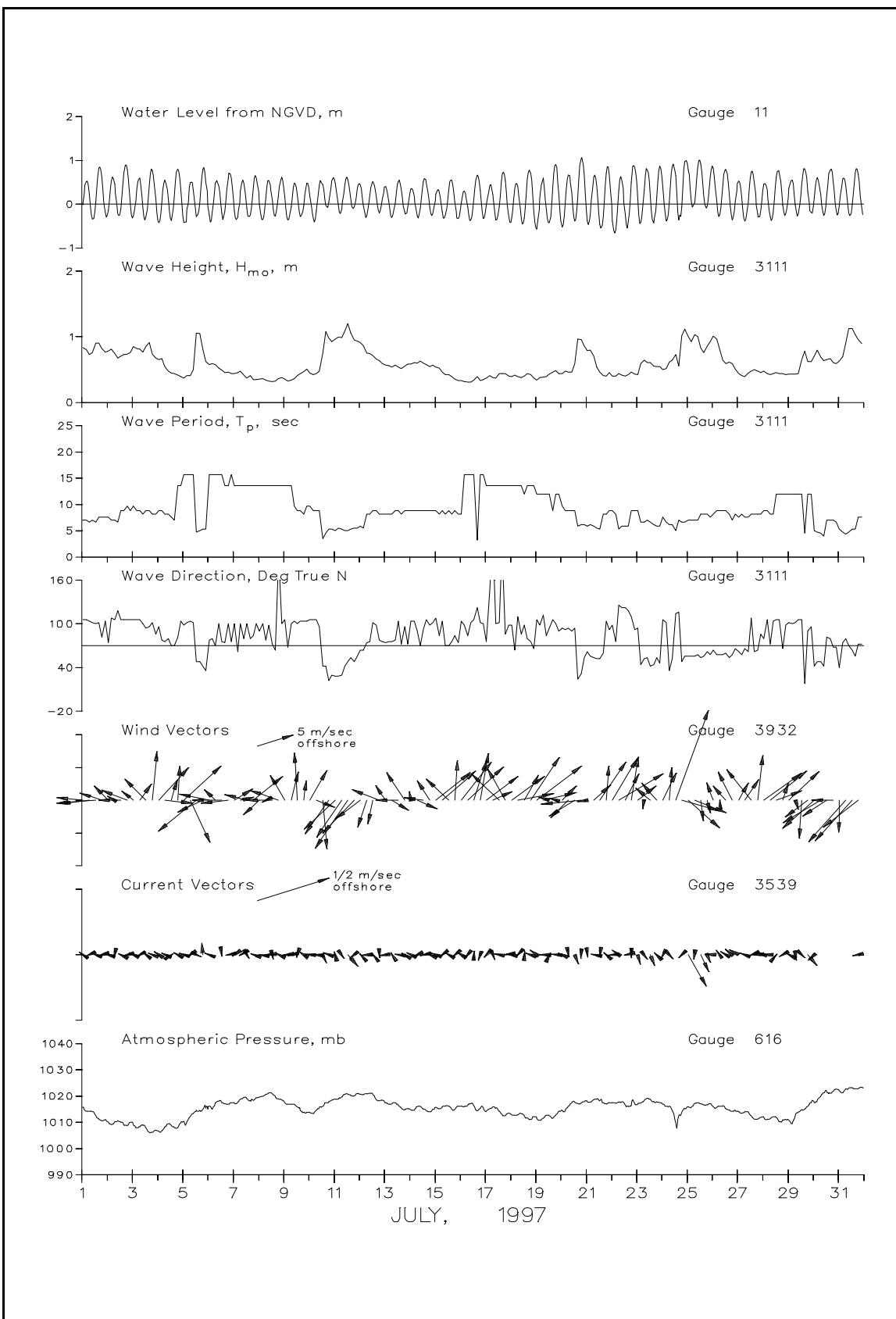


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

		July 1997																																
		Day of the month																																
Gauge ID	Description/Remarks	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1		
616	Atmospheric Pressure	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
604	Precipitation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
624	Air Temperature	-	-	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
		Data Collected	-	-	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3932	Anemometer	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
641	Pressure Gauge on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
625	Baylor staff on FRF pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3111	8 Meter Array 309 m north of FRF	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Pressure Gauge center of 8 Meter Array	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
630	Waverider buoy 4.0 km offshore	-	-	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	-	-	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
3539	Current meter 343 m north of FRF pier (1.6 km offshore)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/		
11	NOAA tide gauge at end of pier	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Visual Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Gauge Status		*	= Operational	/	= Partial	-	= Non-Operational																											
Data Collected		*	= All	/	= Partial	-	= None																											
Visual Observations		*	= Complete	/	= Partial	-	= None																											

Table 2
Gauge Locations

Gauge*	Description	* Latitude	* Longitude	* FRF Coordinates	* Gauge Depth	* Water Depth
ID *		* Degrees N	* Degrees W	* CrossshoreT Longshore*	NGVD, m	* NGVD, m
		*	*	*	*	*
		m	m	m	m	m
616	* Atmospheric Pressure*	36 10' 57.03"	* 75 45' 5.50"	* 11.60	* 569.00	* -----
3932	* Anemometer	* 36 11' 1.23"	* 75 44' 43.07"	* 585.20	* 517.30	* 19.50
641	* Pressure Gauge	* 36 10' 57.71"	* 75 44' 56.23"	* 239.11	* 516.64	* -1.64
625	* Baylor Staff	* 36 11' 1.04"	* 75 44' 43.72"	* 568.00	* 516.64	* Surface
3111	* 8 Meter Array North	* 36 11' 19.14"	* 75 44' 36.41"	* 915.23	* 990.16	* -7.50
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
		*	*	*	*	*
111	* Pressure Gauge in center of 8 M Array	* 36 11' 14.06"	* 75 44' 34.39"	* 914.43	* 825.52	* -7.76
630	* Waverider Buoy	* 36 10' 5.10"	* 75 41' 59.30"	* 3934.96	* -2400.81	* Surface
3539	* Current Meter	* 36 11' 23.57"	* 75 44' 9.12"	* 1605.80	* 907.60	* -11.60
11	* NOAA Tide Gauge	* 36 11' 1.25"	* 75 44' 42.60"	* 596.49	* 514.20	* Surface
R	R	R	R	R	R	R

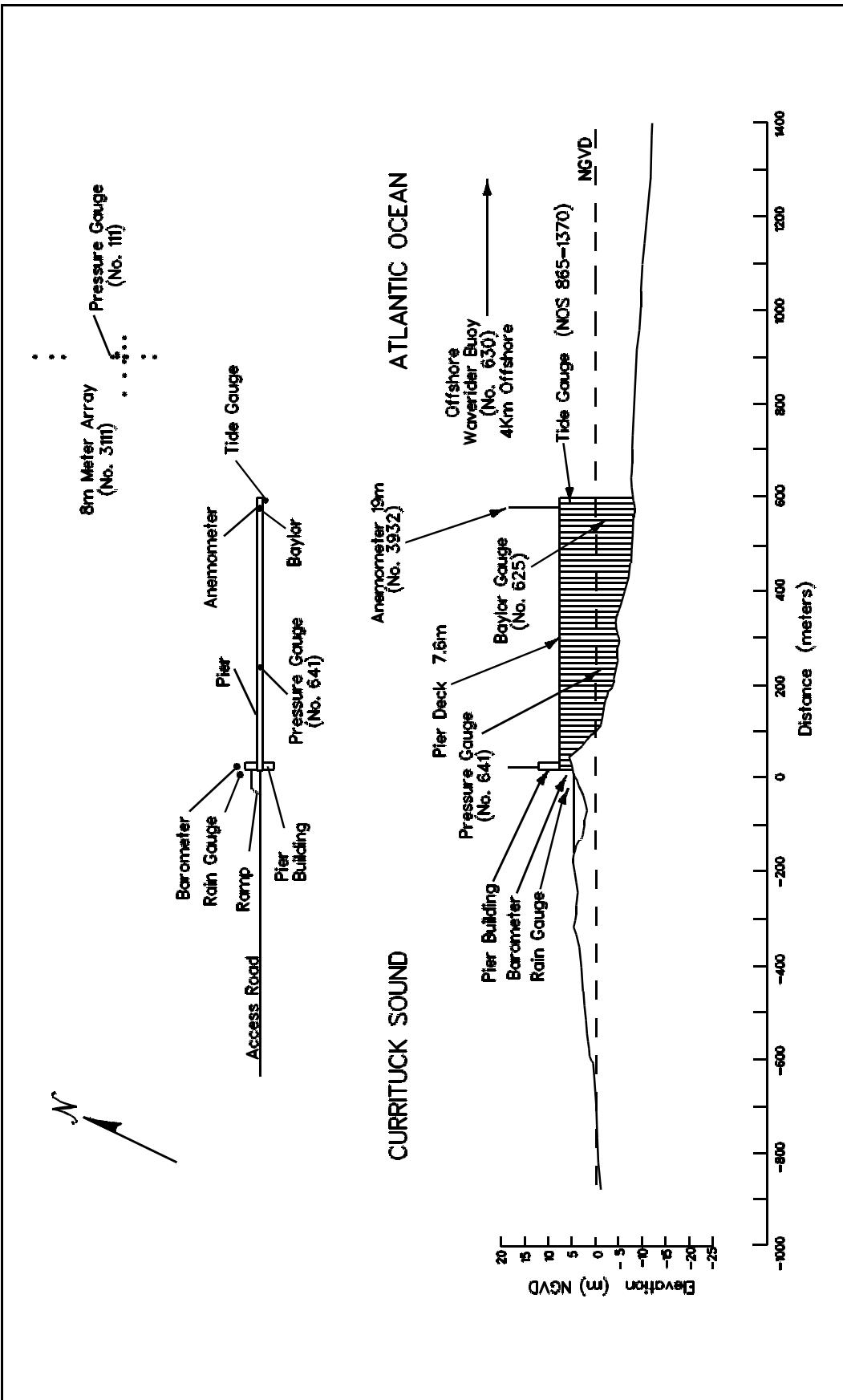


Figure 3. Instrument Locations, Elevations From NGVD

Meteorological Data

2

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

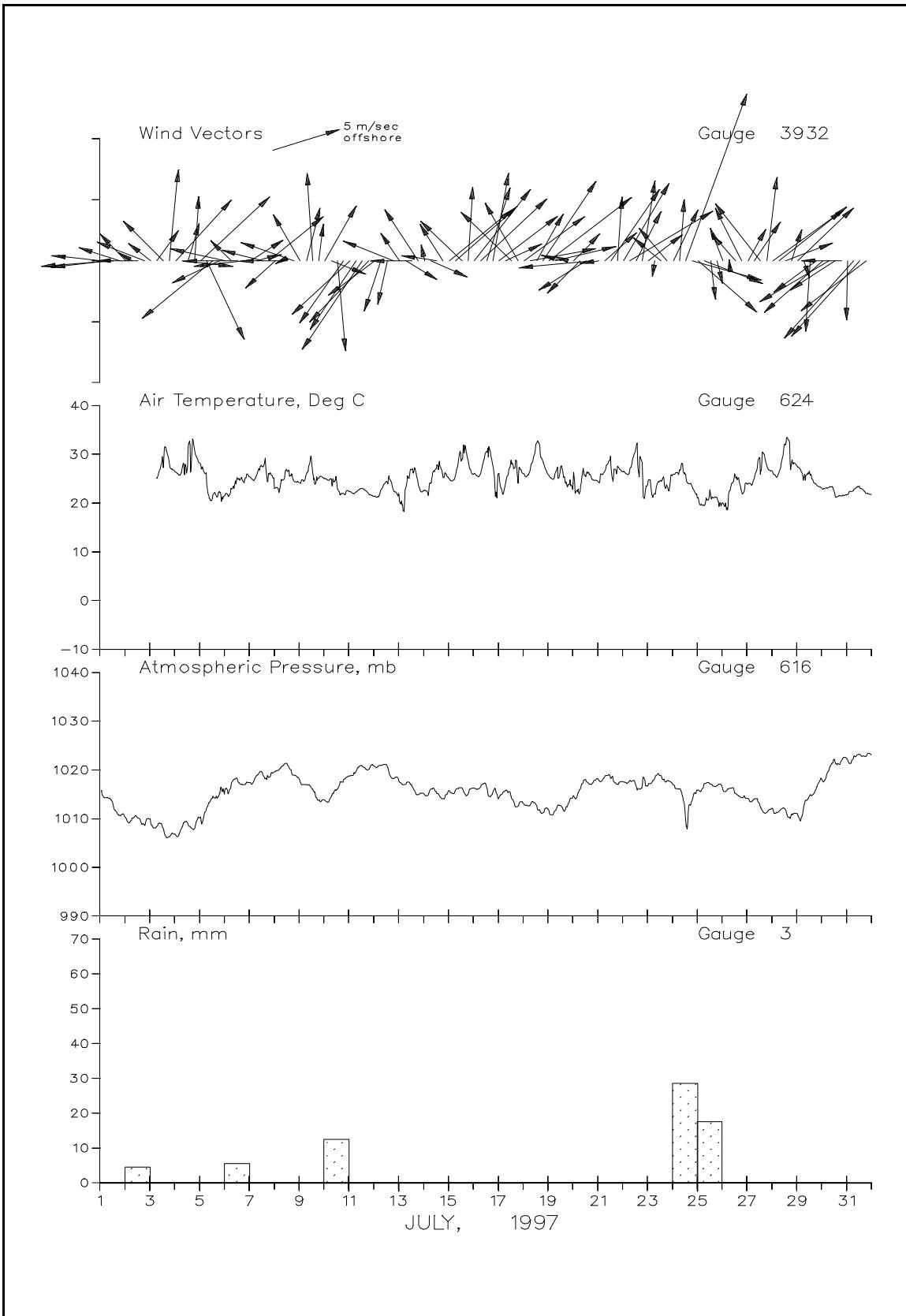


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

Jul 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	4	97		1015.7	0
	700	4	82		1014.4	0
	1300	5	84		1012.6	0
	1900	3	110		1010.7	0
2	100	3	140	inoperative	1010.1	0
	700	1	124		1010.2	5
	1300	3	90		1010.1	0
	1900	4	114		1008.7	0
3	100	2	132		1009.1	0
	700	3	211	25.1	1008.4	0
	1300	4	138	27.2	1008.0	0
	1900	7	184	28.1	1006.3	0
4	100	6	218	26.3	1006.6	0
	700	4	1	27.1	1008.3	0
	1300	3	194	31.4	1008.9	0
	1900	5	183	30.9	1008.0	0
5	100	7	223	28.0	1010.4	0
	700	7	337	23.8	1012.4	0
	1300	7	46	21.6	1014.7	0
	1900	4	61	22.4	1015.0	0
6	100	4	103	21.9	1016.2	0
	700	2	137	22.9	1017.5	6
	1300	4	89	24.9	1017.6	0
	1900	4	82	24.1	1017.0	0
7	100	3	233	25.3	1017.4	0
	700	2	253	25.8	1018.9	0
	1300	3	106	27.4	1019.0	0
	1900	5	226	26.2	1018.5	0
8	100	3	43	23.1	1019.7	0
	700	1	59	24.8	1020.7	0
	1300	3	89	26.4	1021.0	0
	1900	4	111	24.5	1019.0	0
9	100	4	153	24.2	1017.5	0
	700	4	192	26.1	1017.0	0
	1300	7	176	26.2	1016.1	0
	1900	3	185	25.2	1013.8	0
10	100	5	206	25.1	1013.8	0
	700	3	1	25.0	1014.6	13
	1300	7	1	22.9	1016.2	0
	1900	6	1	22.0	1017.9	0

Table 3
Meteorological Data (continued)

Jul 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	6	42	22.4	1018.8	0
	700	7	30	22.2	1019.8	0
	1300	8	30	23.0	1020.8	0
	1900	7	39	21.9	1020.1	0
12	100	4	49	21.4	1020.7	0
	700	4	16	22.7	1020.9	0
	1300	4	10	24.3	1020.8	0
	1900	4	114	22.7	1018.3	0
13	100	3	149	20.3	1017.5	0
	700	3	305	23.3	1017.1	0
	1300	3	89	27.0	1016.6	0
	1900	5	150	23.9	1014.9	0
14	100	1	169	22.7	1014.9	0
	700	3	297	24.0	1016.1	0
	1300	3	99	27.8	1015.1	0
	1900	3	151	25.3	1014.1	0
15	100	6	226	25.0	1015.7	0
	700	6	224	25.7	1015.9	0
	1300	4	138	29.0	1016.3	0
	1900	6	183	28.7	1015.1	0
16	100	7	214	26.2	1016.3	0
	700	7	222	26.1	1016.6	0
	1300	6	195	30.7	1016.4	0
	1900	7	188	27.7	1015.5	0
17	100	5	228	26.1	1014.3	0
	700	3	242	23.9	1015.9	0
	1300	5	138	27.9	1014.2	0
	1900	5	153	24.1	1012.6	0
18	100	6	229	26.0	1013.0	0
	700	5	257	26.9	1012.9	0
	1300	4	206	32.3	1012.6	0
	1900	8	209	28.6	1011.2	0
19	100	8	228	25.7	1011.7	0
	700	4	254	26.0	1011.7	0
	1300	1	108	27.6	1012.5	0
	1900	1	109	23.3	1012.7	0
20	100	3	219	26.4	1014.7	0
	700	4	41	22.4	1016.2	0
	1300	4	54	25.9	1017.7	0
	1900	5	83	24.8	1017.4	0

Table 3
Meteorological Data (concluded)

Jul 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
21	100	1	80	24.3	1017.9	0
	700	3	224	26.6	1018.7	0
	1300	7	210	27.4	1018.3	0
	1900	5	183	27.5	1017.1	0
22	100	7	206	26.5	1017.5	0
	700	7	235	26.6	1017.8	0
	1300	4	203	31.6	1016.6	0
	1900	7	187	28.3	1016.7	0
23	100	3	228	24.7	1017.1	0
	700	1	7	22.0	1018.4	0
	1300	3	133	24.6	1018.8	0
	1900	3	143	23.5	1017.8	0
24	100	5	202	25.9	1016.9	0
	700	5	183	26.8	1016.2	28
	1300	14	197	25.9	1009.9	0
	1900	5	1	23.3	1013.8	0
25	100	6	315	21.1	1015.9	0
	700	4	1	19.5	1017.2	17
	1300	3	353	21.3	1017.1	0
	1900	2	347	21.1	1016.8	0
26	100	3	161	20.0	1015.9	0
	700	0		22.4	1016.2	0
	1300	3	141	25.4	1015.2	0
	1900	5	156	22.3	1014.4	0
27	100	3	205	24.1	1014.1	0
	700	4	210	25.0	1014.1	0
	1300	6	145	25.9	1012.5	0
	1900	7	185	27.6	1011.3	0
28	100	6	230	26.2	1011.9	0
	700	7	227	26.3	1011.5	0
	1300	4	246	31.9	1011.9	0
	1900	3	195	28.4	1011.0	0
29	100	6	222	27.3	1010.8	0
	700	1	344	25.2	1012.5	0
	1300	6	3	25.8	1014.9	0
	1900	4	49	23.7	1016.3	0
30	100	6	44	22.8	1017.6	0
	700	6	55	23.2	1019.9	0
	1300	4	52	21.5	1021.6	0
	1900	3	90	21.5	1022.0	0
31	100	5	1	21.7	1022.1	0
	700	8	37	22.8	1022.8	0
	1300	8	38	23.3	1023.2	0
	1900	6	48	22.0	1022.8	0
			Resultant	Mean	Mean	Total
		2	168	25.1	1015.5	69

Wave Data

3

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using an iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

Jul 1997										
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider	
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec
1	0100	0.42	6.8	0.73	6.6	0.84	7.1	106		
	0700	0.38	6.6	0.66	6.3	0.73	6.6	104		
	1300	0.47	7.2	0.81	7.0	0.90	6.6	100		
	1900	0.46	7.4	0.72	7.6	0.82	7.6	82		
2	0100	0.37	7.8	0.69	7.0	0.78	7.6	74	inoperative	
	0700	0.40	7.2	0.69	7.2	0.74	7.1	106		
	1300	0.32	6.6	0.60	6.0	0.70	8.9	106		
	1900	0.48	9.9	0.68	9.5	0.74	9.8	106		
3	0100	0.40	9.9	0.67	9.9	0.85	9.8	106		
	0700	0.44	8.9	0.72	8.9	0.82	8.9	106		
	1300	0.40	9.2	0.71	8.6	0.85	8.9	94	1.08	8.3
	1900	0.50	8.3	0.74	8.3	0.74	8.2	102	0.89	7.7
4	0100	0.28	7.2	0.58	8.6	0.65	8.9	96	inoperative	
	0700	0.32	8.6	0.52	8.6	0.55	8.2	76		
	1300	0.19	13.5	0.40	7.8	0.45	7.6	70	0.48	7.7
	1900	0.28	16.0	0.35	13.5	0.42	13.6	82	0.46	13.4
5	0100	0.17	16.0	0.31	16.0	0.37	15.7	98	0.49	13.4
	0700	0.26	16.0	0.42	16.0	0.41	15.7	104	0.57	12.6
	1300	0.56	4.5	0.88	4.2	1.05	4.8	48	0.95	4.1
	1900	0.67	5.1	0.90	4.5	0.81	5.3	42	1.15	5.3
6	0100	0.38	5.0	0.60	4.3	0.58	15.7	78	0.72	5.1
	0700	0.37	15.1	0.61	15.1	0.58	15.7	70	0.68	15.4
	1300	0.30	4.4	0.49	15.1	0.49	15.7	76	0.52	14.3
	1900	0.29	14.3	0.45	15.1	0.46	13.6	100	0.56	14.3
7	0100	0.24	15.1	0.41	14.3	0.44	13.6	100	0.52	14.3
	0700	0.28	14.3	0.47	14.3	0.48	13.6	100	0.56	14.3
	1300	0.21	14.3	0.38	14.3	0.37	13.6	100	0.45	14.3
	1900	0.20	13.5	0.33	13.5	0.34	13.6	84	0.60	14.3
8	0100	0.20	14.3	0.36	13.5	0.35	13.6	90	0.41	13.4
	0700	0.22	14.3	0.34	13.5	0.34	13.6	78	0.37	13.4
	1300	0.21	13.5	0.34	13.5	0.32	13.6	72	0.38	14.3
	1900	0.24	13.5	0.38	12.9	0.36	13.6	204	0.47	13.4
9	0100	0.23	13.5	0.37	12.9	0.35	13.6	106	0.49	12.6
	0700	0.21	15.1	0.31	12.2	0.34	13.6	100	0.40	11.8
	1300	0.25	9.9	0.41	9.5	0.41	8.9	100	0.49	7.7
	1900	0.26	8.9	0.41	8.1	0.47	8.2	104	0.52	8.4
10	0100	0.26	9.5	0.43	8.9	0.44	9.8	106	0.53	9.1
	0700	0.24	8.9	0.40	9.5	0.44	8.9	106	0.47	9.1
	1300	0.29	9.2	0.48	9.2	0.75	3.5	42	0.60	9.1
	1900	0.77	5.5	0.95	5.2	0.98	5.3	22	1.11	5.1

Table 4
Wave Data (continued)

Jul 1997											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
11	0100	0.77	5.6	0.94	5.2	0.96	5.0	28	1.16	5.6	
	0700	0.77	5.3	0.99	5.2	0.99	5.3	30	1.24	5.3	
	1300	0.91	5.4	1.09	4.8	1.20	5.0	48	1.17	4.6	
	1900	0.70	5.5	0.93	5.5	0.95	5.6	48	1.16	5.6	
12	0100	0.49	5.2	0.88	5.5	0.91	5.9	64	1.04	5.6	
	0700	0.33	8.3	0.78	8.9	0.75	8.2	74	0.84	5.3	
	1300	0.36	8.6	0.72	8.3	0.72	8.9	102	0.82	8.4	
	1900	0.27	8.9	0.65	8.9	0.63	8.2	78	0.72	9.1	
13	0100	0.29	9.2	0.57	8.9	0.57	8.2	74	0.68	8.4	
	0700	0.24	7.8	0.46	8.6	0.54	8.2	76	0.61	7.7	
	1300	0.30	8.6	0.48	8.6	0.54	8.9	104	0.61	8.4	
	1900	0.25	8.3	0.43	9.2	0.56	8.9	96	0.57	9.1	
14	0100	0.31	8.9	0.50	8.9	0.58	8.9	104	0.69	9.1	
	0700	0.29	5.5	0.56	6.5	0.60	8.9	90	0.73	5.9	
	1300	0.34	8.6	0.53	9.2	0.60	8.9	92	0.67	7.7	
	1900	0.29	9.2	0.42	9.5	0.55	8.9	98	0.64	8.4	
15	0100	0.32	9.2	0.47	8.9	0.54	8.9	108	0.66	9.1	
	0700	0.23	9.2	0.40	7.8	0.46	8.9	104	0.59	5.9	
	1300	0.23	16.0	0.34	8.6	0.43	8.9	70	0.47	9.1	
	1900	0.20	15.1	0.29	8.6	0.35	8.9	84	0.49	8.4	
16	0100	0.18	15.1	0.28	8.6	0.33	8.2	104	0.43	7.7	
	0700	0.15	15.1	0.27	15.1	0.31	15.7	84	0.39	8.4	
	1300	0.18	14.3	0.27	8.3	0.34	15.7	106	0.34	14.3	
	1900	0.22	15.1	0.32	15.1	0.34	15.7	102	0.46	15.4	
17	0100	0.22	14.3	0.38	15.1	0.37	13.6	76	0.41	14.3	
	0700	0.25	14.3	0.37	14.3	0.38	13.6	212	0.46	14.3	
	1300	0.23	14.3	0.34	13.5	0.44	13.6	102	0.48	13.4	
	1900	0.26	13.5	0.40	13.5	0.44	13.6	86	0.56	13.4	
18	0100	0.20	13.5	0.38	13.5	0.40	13.6	98	0.49	13.4	
	0700	0.24	13.5	0.38	13.5	0.40	13.6	110	0.46	13.4	
	1300	0.20	12.9	0.34	12.9	0.40	12.0	98	0.48	12.6	
	1900	0.28	12.9	0.40	12.9	0.43	13.6	76	0.54	12.6	
19	0100	0.16	12.2	0.29	12.9	0.34	12.0	106	0.49	12.6	
	0700	0.23	12.9	0.34	12.9	0.38	12.0	112	0.48	12.6	
	1300	0.21	12.2	0.38	9.5	0.43	12.0	94	0.50	9.1	
	1900	0.29	8.9	0.44	8.9	0.49	12.0	100	0.62	9.1	
20	0100	0.20	10.3	0.39	8.9	0.44	9.8	94	0.55	10.1	
	0700	0.28	8.9	0.42	9.2	0.46	8.9	94	0.57	10.1	
	1300	0.28	8.6	0.51	8.9	0.59	8.9	94	0.64	9.1	
	1900	0.75	6.6	0.90	6.3	0.96	6.2	32	1.31	5.6	

Table 4
Wave Data (concluded)

Jul 1997											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
21	0100	0.54	6.0	0.79	6.5	0.79	5.9	62	0.97	6.3	
	0700	0.60	5.9	0.73	6.0	0.71	5.9	54	0.86	5.3	
	1300	0.26	5.5	0.43	5.5	0.46	5.3	52	0.52	5.6	
	1900	0.23	8.1	0.36	9.5	0.40	8.2	104	0.50	8.4	
22	0100	0.21	4.3	0.42	8.9	0.40	8.9	98	0.59	8.4	
	0700	0.24	5.7	0.41	4.7	0.44	5.3	126	0.61	5.1	
	1300	0.20	6.3	0.38	9.2	0.41	5.9	122	0.54	5.6	
	1900	0.28	8.9	0.40	8.6	0.46	8.9	110	0.65	5.6	
23	0100	0.24	6.3	0.40	9.2	0.42	8.9	94	0.54	5.3	
	0700	0.52	5.9	0.62	7.0	0.64	6.6	52	0.79	5.1	
	1300	0.49	6.5	0.56	5.2	0.61	6.6	42	0.80	5.6	
	1900	0.42	5.3	0.56	6.0	0.54	5.9	54	0.71	5.9	
24	0100	0.37	5.3	0.55	7.4	0.50	7.6	106	0.61	7.7	
	0700	0.46	6.3	0.59	6.1	0.62	6.2	36	0.74	6.7	
	1300	0.46	6.6	0.74	5.0	0.73	5.0	114	1.01	4.4	
	1900	0.76	5.7	0.76	6.3	1.02	6.6	48	0.96	6.7	
25	0100	0.91	5.7	1.00	6.5	1.00	7.1	56	1.26	7.2	
	0700	0.82	6.8	0.89	7.0	1.03	7.1	56	1.28	6.7	
	1300	0.84	7.4	0.82	7.0	0.83	8.2	54	0.97	8.4	
	1900	0.61	7.6	0.78	7.8	0.86	8.2	62	0.88	7.7	
26	0100	0.72	8.1	0.85	8.3	1.01	8.2	64	1.24	8.4	
	0700	0.47	9.5	0.75	9.5	0.80	8.9	58	0.98	9.1	
	1300	0.41	8.9	0.55	9.2	0.59	8.9	60	0.68	8.4	
	1900	0.25	7.6	0.49	7.6	0.59	7.1	58	0.72	7.7	
27	0100	0.24	7.6	0.41	7.8	0.44	7.6	62	0.55	8.4	
	0700	0.18	7.8	0.37	8.3	0.40	7.6	66	0.46	7.7	
	1300	0.26	8.6	0.41	8.1	0.47	8.2	108	0.52	7.2	
	1900	0.23	7.8	0.41	7.8	0.48	8.2	64	0.65	6.7	
28	0100	0.27	8.9	0.41	8.6	0.47	8.9	80	0.62	8.4	
	0700	0.19	8.3	0.37	8.6	0.43	8.2	72	0.56	8.4	
	1300	0.25	11.7	0.41	11.7	0.46	12.0	106	0.52	12.6	
	1900	0.23	11.7	0.40	8.6	0.44	12.0	66	0.53	11.8	
29	0100	0.25	11.7	0.37	11.7	0.43	12.0	102	0.54	10.6	
	0700	0.23	12.2	0.39	12.2	0.43	12.0	102	0.52	12.6	
	1300	0.35	11.7	0.52	11.7	0.66	12.0	106	0.68	7.7	
	1900	0.46	4.7	0.62	11.7	0.63	12.0	90	0.90	11.8	
30	0100	0.51	5.2	0.63	11.2	0.70	5.0	42	0.91	5.1	
	0700	0.54	4.7	0.71	4.2	0.69	4.6	48	0.86	4.8	
	1300	0.38	4.9	0.62	4.1	0.66	7.1	82	0.83	6.3	
	1900	0.34	4.7	0.62	6.6	0.61	7.1	68	0.74	11.8	
31	0100	0.42	5.3	0.62	5.4	0.63	5.3	40	0.79	5.3	
	0700	0.51	4.8	0.87	4.2	0.91	4.4	80	1.02	4.2	
	1300	0.67	5.0	1.09	4.8	1.13	5.3	64	1.35	5.1	
	1900	0.58	5.1	0.94	5.1	0.96	7.6	72	1.14	5.1	
Mean		0.36	9.2	0.55	9.1	0.59	9.4	84	0.69	9.0	
Std dev		0.18	3.5	0.20	3.1	0.21	3.2	28	0.25	3.2	

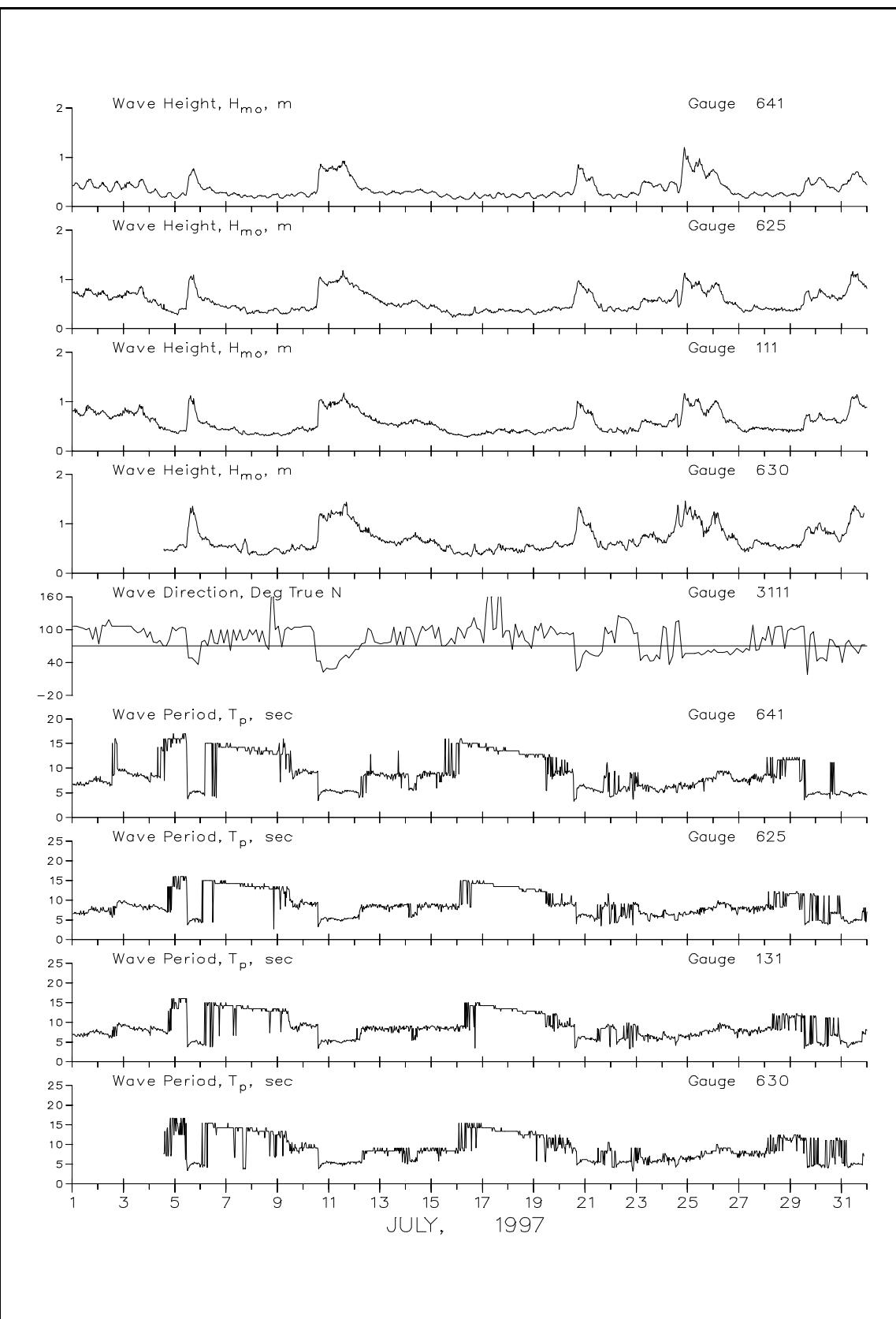


Figure 5. Wave Heights and Periods

Current Data

4

Current data (Table 5) are collected from a Marsh-McBirney electromagnetic biaxial current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

JULY 1997																	
	Cross				Long					Cross				Long			
Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir
1	100	2	-2	3	309		1300	-2	11	11	143	22	100	3	0	3	264
	700	3	1	3	239		1900	3	1	4	228		700	3	-4	6	309
	1300	2	-1	3	293	12	100	0	0	0			1300	1	0	1	258
	1900	3	0	3	253		700	3	0	3	267		1900	1	2	2	181
2	100	2	-1	3	288		1300	0	0	0		23	100	1	7	7	166
	700	1	2	2	190		1900	1	2	2	176		700	0	4	4	148
	1300	1	-1	2	300	13	100	4	0	4	260		1300	0	9	9	161
	1900	3	0	3	255		700	0	-1	2	330		1900	1	-1	2	318
3	100	2	-1	3	297		1300	2	0	2	279	24	100	2	2	3	204
	700	3	1	3	237		1900	1	-1	2	304		700	0	4	4	141
	1300	1	-2	3	311	14	100	2	-1	3	297		1300	inoperative			
	1900	2	-1	3	293		700	3	0	3	242		1900	3	1	3	222
4	100	2	-2	4	306		1300	2	0	2	255	25	100	-2	26	27	154
	700	2	-1	3	296		1900	1	-1	2	297		700	2	3	4	188
	1300	0	0	0		15	100	3	-1	3	291		1300	0	14	14	158
	1900	2	-1	3	303		700	2	1	2	229		1900	0	6	6	159
5	100	3	-1	3	289		1300	2	-1	3	304	26	100	5	-1	5	274
	700	2	1	2	233		1900	2	1	2	226		700	1	-3	4	327
	1300	-1	2	3	118	16	100	2	-2	3	305		1300	2	-2	4	305
	1900	-1	-8	9	355		700	3	2	3	217		1900	3	-5	6	311
6	100	2	-1	3	294		1300	0	-2	3	3	27	100	4	-5	7	302
	700	inoperative					1900	3	3	4	199		700	3	-1	3	292
	1300	0	1	1	173	17	100	2	1	2	221		1300	2	0	2	245
	1900	2	0	2	259		700	0	4	4	161		1900	3	0	3	267
7	100	2	1	2	231		1300	3	-1	4	283	28	100	4	-2	5	293
	700	1	0	1	238		1900	1	0	1	262		700	5	-1	5	273
	1300	0	3	3	153	18	100	3	-1	3	286		1300	0	0	0	
	1900	1	0	2	292		700	2	1	2	219		1900	3	1	3	235
8	100	1	0	1	279		1300	0	-1	3	4	29	100	1	-1	2	300
	700	0	0	0			1900	3	-1	3	292		700	1	4	4	173
	1300	1	4	4	167	19	100	3	-4	6	309		1300	0	3	3	137
	1900	2	-1	2	298		700	2	0	2	272		1900	-2	9	10	145
9	100	1	0	1	264		1300	0	0	0		30	100	5	3	6	222
	700	2	0	2	255		1900	3	0	3	276		700				
	1300	1	2	2	195	20	100	2	-1	3	296		1300				
	1900	2	-2	4	309		700	0	2	2	172		1900				
10	100	3	0	3	275		1300	0	7	7	160	31	100	inoperative			
	700	2	0	2	276		1900	1	3	3	184		700				
	1300	0	7	7	158	21	100	0	2	2	174		1300				
	1900	3	-2	4	291		700	2	0	2	281		1900	4	0	4	257
11	100	0	-1	2	347		1300	1	1	2	187						
	700	0	3	3	149		1900	1	-1	2	316						

KEY:

+cross-shore = offshore, cm/sec
 -cross-shore = onshore, cm/sec
 +longshore = south, cm/sec
 -longshore = north, cm/sec
 Speed = Resultant speed, cm/sec
 Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

Day	Jul 1997											
	Pier End				Mid-Surf Zone				Beach			
	Cross Shore	Long Shore	Speed	Dir	Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir	
1	4	-29	29	349	3	-68	68	343	South	34	N	
2	2	-23	23	346	-15	-44	46	321	South	27	N	
3	3	-19	19	349	-24	-68	72	321	South	26	N	
4	-2	11	11	169	-11	-55	57	329	South	21	N	
5	-3	30	31	166	4	-28	28	349	South	14	N	
6	-10	51	52	171	-4	-23	24	331	South	14	N	
7	3	20	21	151	-16	-27	31	309	South	18	N	
8	-3	9	10	177	-15	-51	53	323	North	3	S	
9	13	-27	30	7	-10	-68	68	331	South	15	N	
10	0	-18	18	340	-32	-36	48	298	South	2		
11	-10	23	25	184	-23	76	80	177	North	45	S	
12	5	36	36	151	14	-23	26	11	North	7	S	
13	0	0	0		0	-51	51	340	North	8	N	
14	6	-9	11	15	-20	-68	71	323	South	61	N	
15	7	-23	24	357	16	-36	39	4	South	13	N	
16	25	-11	27	46	-26	-87	91	323	South	5	N	
17	7	11	13	129	-16	-36	39	316	South	20	N	
18	21	10	23	95	-131	-87	157	284	South	49	N	
19	9	5	10	97	-34	-76	84	316	South	5	N	
20	-9	-4	9	275	-91	-76	119	290	South	18	N	
21	6	25	26	146	-12	61	62	171	North	14	S	
22	-8	-17	19	316	-9	-44	44	329	South	9	N	
23	12	14	18	118	-10	51	52	171	North	14	S	
24	3	13	13	149	6	-41	41	349	South	8	N	
25	-2	30	31	163	-12	61	62	171	North	27	S	
26	6	-28	28	351	0	0	0		no observation			
27	6	-20	21	357	-5	-18	19	323	South	10	N	
28	16	-13	21	30	7	-36	37	351	South	32	N	
29	0	0	0		-7	-44	44	331	South	49	N	
30	-12	41	42	177	-8	41	41	171	North	8	S	
31	-14	55	57	174	-8	41	41	171	North	44	S	

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Visual Observations

5

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

Day	Time	Wave Approach		Water Characteristics			
		Angle at Pier End (degrees from True N)		at Pier End			
		Primary	Secondary	Surf Zone Width, m	Temp., C	Density g/cc	Secchi Vis.,m
1	0645	110		55	20.0	1.0228	1.8
2	0607	105		52	17.8	1.0240	2.7
3	0606	105		57	18.3	1.0238	2.4
4	1050	105		42	17.2	1.0242	1.8
5	0936	110		33	16.7	1.0244	2.7
6	0939	105		33	23.9	1.0200	2.1
7	0708	110		33	24.4	1.0182	2.1
8	0745	70	150	34	24.7	1.0190	2.7
9	0805	100	150	28	23.3	1.0206	2.7
10	0805	70	130	34	19.7	1.0235	3.0
11	0753	30		57	22.8	1.0221	4.0
12	0645	65	80	59	22.2	1.0200	2.4
13	0530	80	105	24	22.8	1.0218	1.8
14	0811	105		51	23.9	1.0224	3.0
15	0810	75	130	30	21.1	1.0235	2.7
16	0807	95	50	37	18.3	1.0250	2.4
17	0815	75	40	44	16.9	1.0250	3.7
18	0808	110		28	18.3	1.0248	2.7
19	0658	120		21	17.2	1.0250	3.4
20	0845	110		31	22.8	1.0242	4.0
21	0632	40		47	25.0	1.0189	2.4
22	0613	140		35	18.3	1.0250	2.1
23	0754	100		42	18.9	1.0244	2.7
24	0610	115		41	23.3	1.0210	3.0
25	0619	30		52	21.1	1.0212	2.4
26	1015	45		34	22.8	1.0204	2.1
27	1000	90		30	21.9	1.0218	2.1
28	0613	100		52	22.2	1.0232	3.0
29	0602	110		51	21.7	1.0234	3.7
30	0600	45		51	23.9	1.0202	2.7
31	0601	55		47	23.9	1.0186	2.1

Water Levels

6

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level. Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

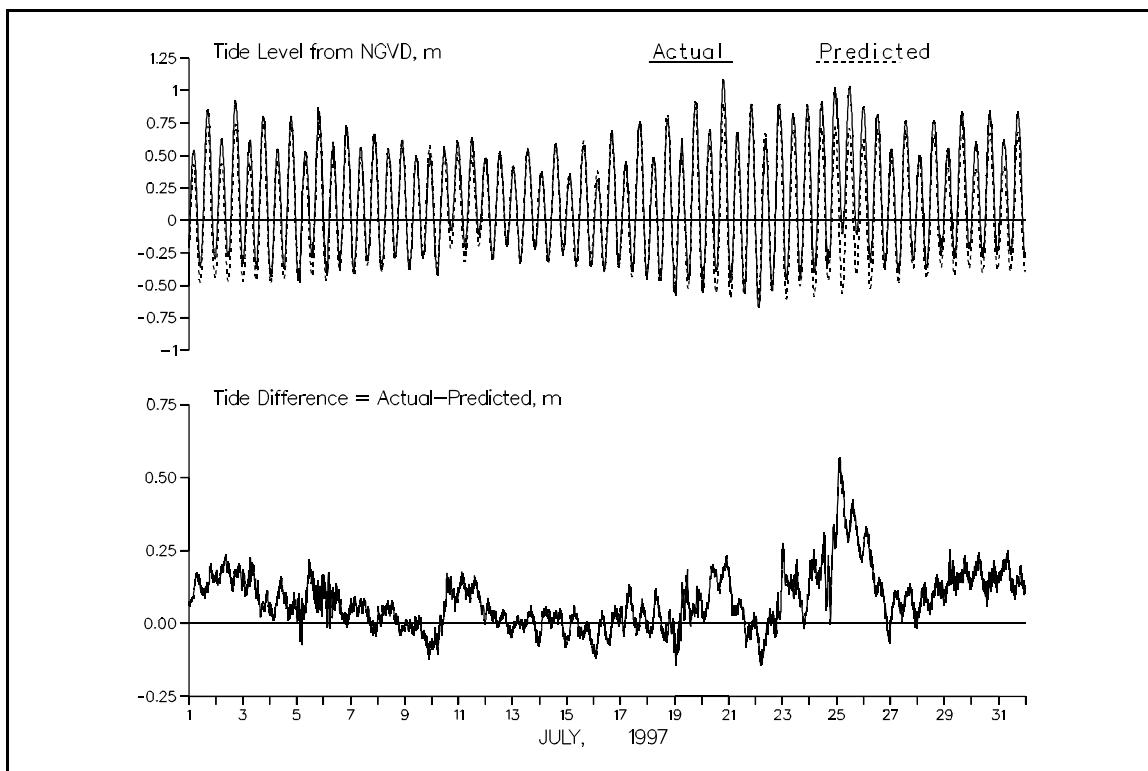


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

JUL 1997 Tide Levels																		
Day	High			Low			Mean	Range	High			Low			Mean	Range		
	Day	Time	m	Day	Time	m			Day	Time	m	Day	Time	m				
1	0436	0.54	1	0000	-0.21	0.30	0.76	16	1642	0.69	16	0954	-0.39	0.13	1.08			
1	1700	0.86	1	1018	-0.36	0.26	1.22	17	0436	0.46	16	2230	-0.37	0.07	0.82			
2	0536	0.63	1	2330	-0.30	0.17	0.93	17	1724	0.76	17	1018	-0.39	0.18	1.16			
2	1730	0.93	2	1036	-0.28	0.30	1.21	18	0524	0.49	17	2318	-0.45	0.04	0.94			
3	0642	0.62	2	2348	-0.33	0.15	0.96	18	1800	0.78	18	1136	-0.46	0.15	1.24			
3	1754	0.81	3	1212	-0.37	0.23	1.18	19	0636	0.64	19	0106	-0.58	0.00	1.22			
4	0700	0.55	4	0106	-0.44	0.06	0.99	19	1818	0.92	19	1224	-0.46	0.23	1.38			
4	1918	0.81	4	1300	-0.37	0.21	1.18	20	0736	0.71	20	0106	-0.54	0.11	1.25			
5	0712	0.53	5	0242	-0.48	0.06	1.01	20	1936	1.09	20	1248	-0.40	0.33	1.49			
5	1924	0.87	5	1318	-0.29	0.26	1.16	21	0748	0.68	21	0136	-0.48	0.11	1.16			
6	0830	0.61	6	0324	-0.41	0.11	1.02	21	2024	0.89	21	1412	-0.56	0.15	1.46			
6	2006	0.74	6	1418	-0.36	0.20	1.09	22	0900	0.63	22	0242	-0.68	-0.02	1.31			
7	0836	0.56	7	0236	-0.38	0.09	0.95	22	2048	0.90	22	1500	-0.54	0.20	1.44			
7	2118	0.67	7	1518	-0.32	0.17	0.98	23	0924	0.83	23	0312	-0.46	0.20	1.28			
8	0918	0.56	8	0324	-0.39	0.09	0.94	23	2218	0.89	23	1542	-0.45	0.23	1.35			
8	2154	0.62	8	1530	-0.29	0.16	0.91	24	1054	0.92	24	0436	-0.40	0.26	1.32			
9	1012	0.50	9	0348	-0.38	0.06	0.88	24	2236	1.03	24	1600	-0.36	0.36	1.39			
9	2236	0.51	9	1554	-0.29	0.09	0.80	25	1142	1.03	25	0536	-0.11	0.48	1.14			
10	1124	0.57	10	0524	-0.43	0.09	1.00	26	0006	0.88	25	1748	-0.11	0.39	0.99			
10	2236	0.62	10	1812	-0.08	0.26	0.70	26	1248	0.82	26	0612	-0.33	0.27	1.15			
11	1148	0.64	11	0606	-0.22	0.22	0.86	27	0112	0.55	26	1900	-0.37	0.11	0.92			
12	0018	0.48	11	1806	-0.11	0.19	0.60	27	1354	0.77	27	0712	-0.40	0.19	1.17			
12	1236	0.53	12	0612	-0.31	0.12	0.83	28	0224	0.50	27	2012	-0.32	0.11	0.82			
13	0054	0.41	12	1900	-0.20	0.10	0.61	28	1500	0.77	28	0754	-0.38	0.21	1.15			
13	1336	0.56	13	0642	-0.33	0.12	0.88	29	0406	0.56	28	2054	-0.27	0.16	0.83			
14	0224	0.38	13	2000	-0.23	0.08	0.61	29	1512	0.84	29	0824	-0.29	0.29	1.13			
14	1430	0.59	14	0806	-0.32	0.14	0.91	30	0424	0.61	29	2242	-0.22	0.20	0.83			
15	0318	0.34	14	2048	-0.27	0.05	0.61	30	1648	0.84	30	1012	-0.29	0.27	1.13			
15	1530	0.58	15	0824	-0.34	0.12	0.92	31	0512	0.63	30	2242	-0.26	0.20	0.89			
16	0342	0.32	15	2154	-0.36	-0.01	0.67	31	1724	0.84	31	1112	-0.27	0.28	1.11			

Bathymetry

7

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using a Trimble 4000 SSE GPS for positioning, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in May and the survey(s) in June on profile line 188, located 517 m south of the pier.

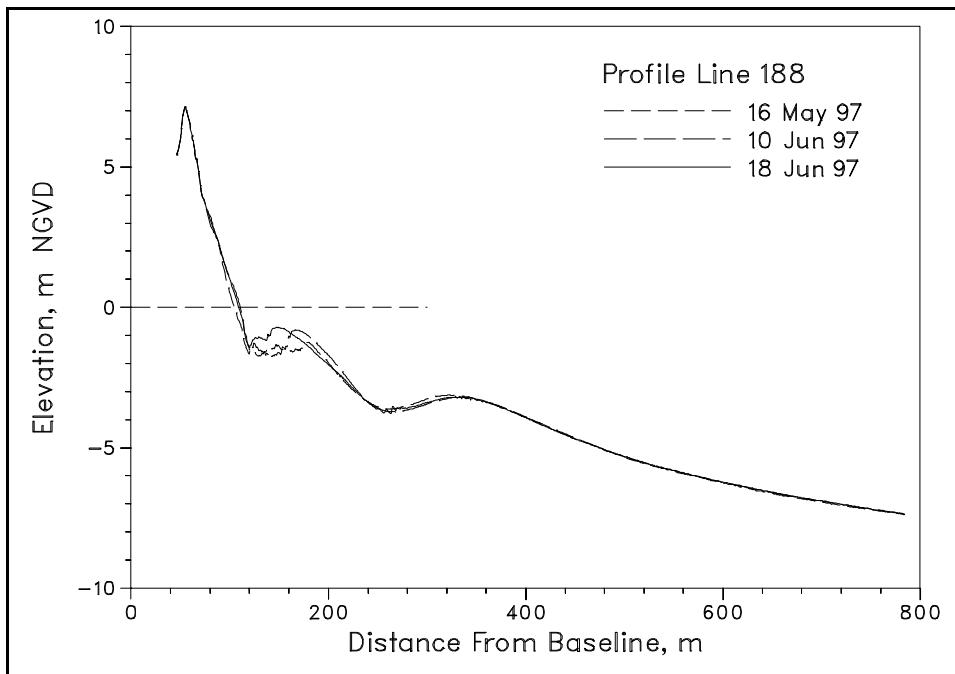


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 1997. Cross-hatched areas indicate changes to the annual envelope which occurred in July.

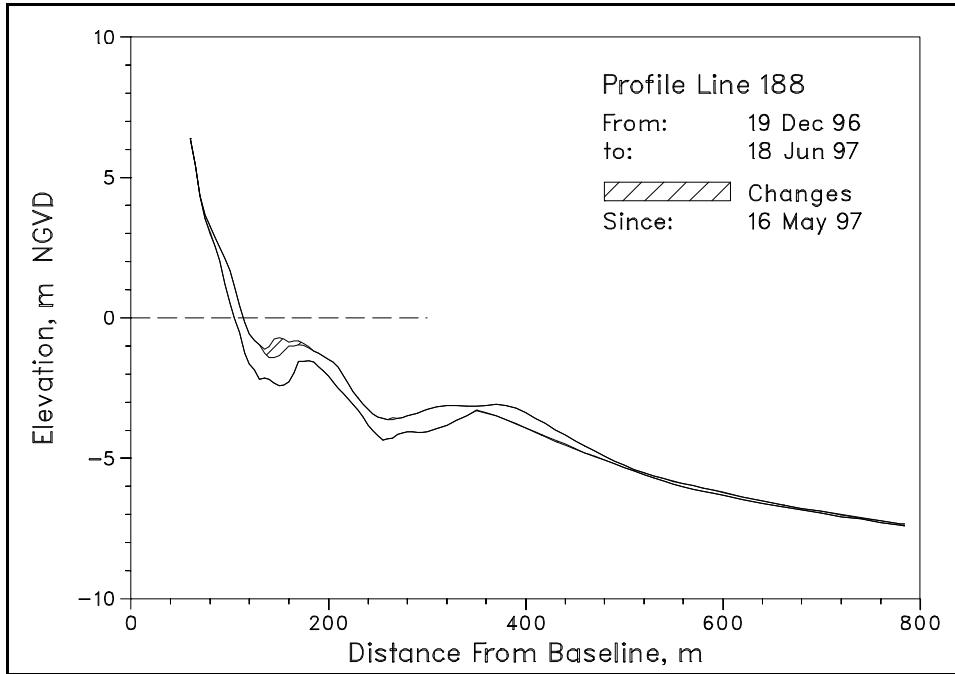
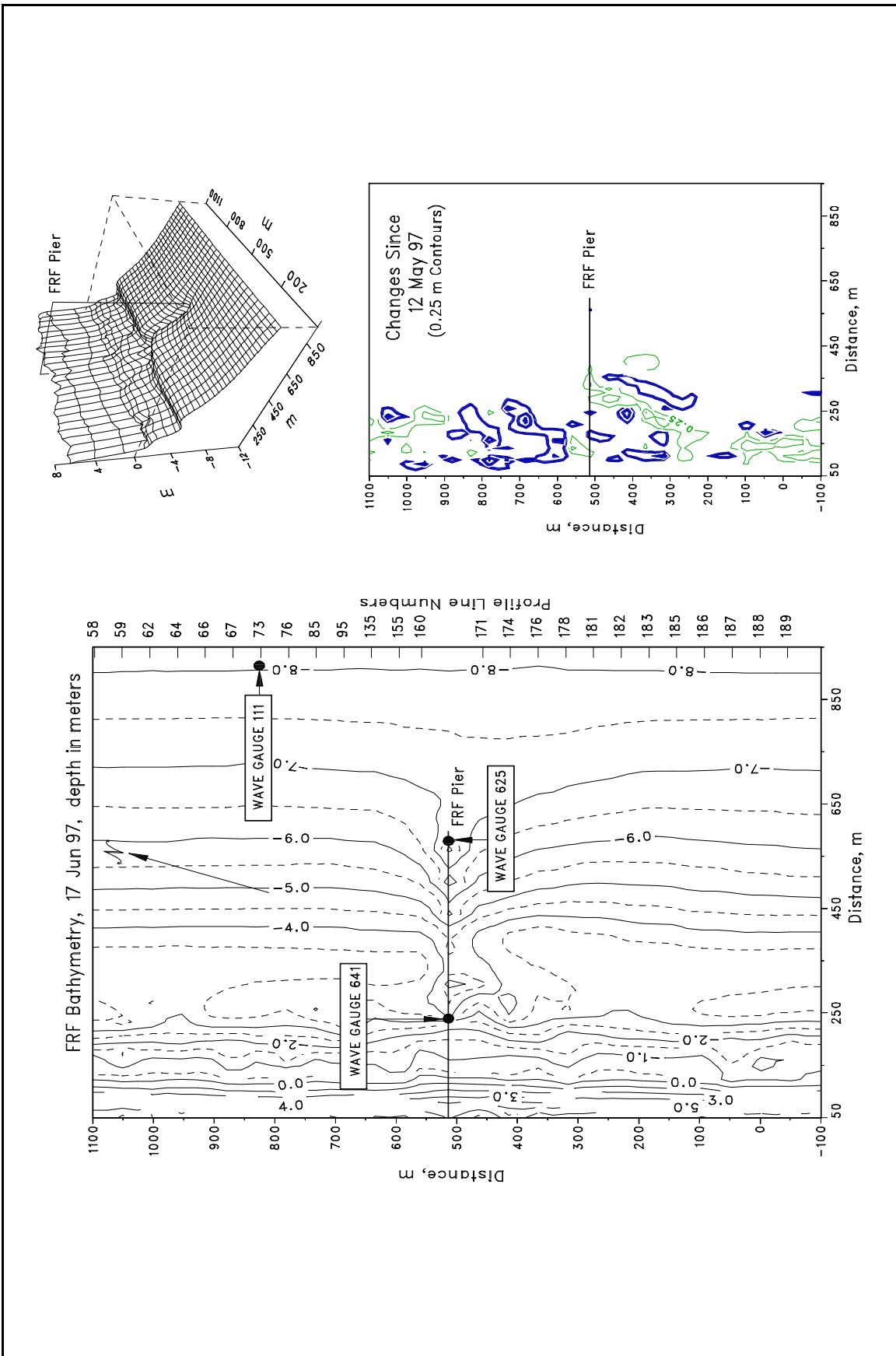


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 17 June. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

There were no surveys during the month of July due to preparations for the SandyDuck experiment. These plots are included for reference only.



Special Events

8

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

	<u>Start</u>	<u>End</u>
** Dec (0000)	** Dec (0000)	

B. Storm Synopsis.

Northeasterly winds were funneled between a Canadian high pressure system and a low pressure system over Cape Hatteras. Winds intensified as the low pressure system moved along the North Carolina coast and began moving out to sea by the morning of ** July. Maximum onshore winds (NE) reached ** m/s at 0000 EST on ** July. The minimum atmospheric pressure was *** mb. The maximum H_{mo} , at gauge 630, reached *.* m ($T_p=**.*$ s) at 0000 EST on ** July. There was * mm of precipitation.